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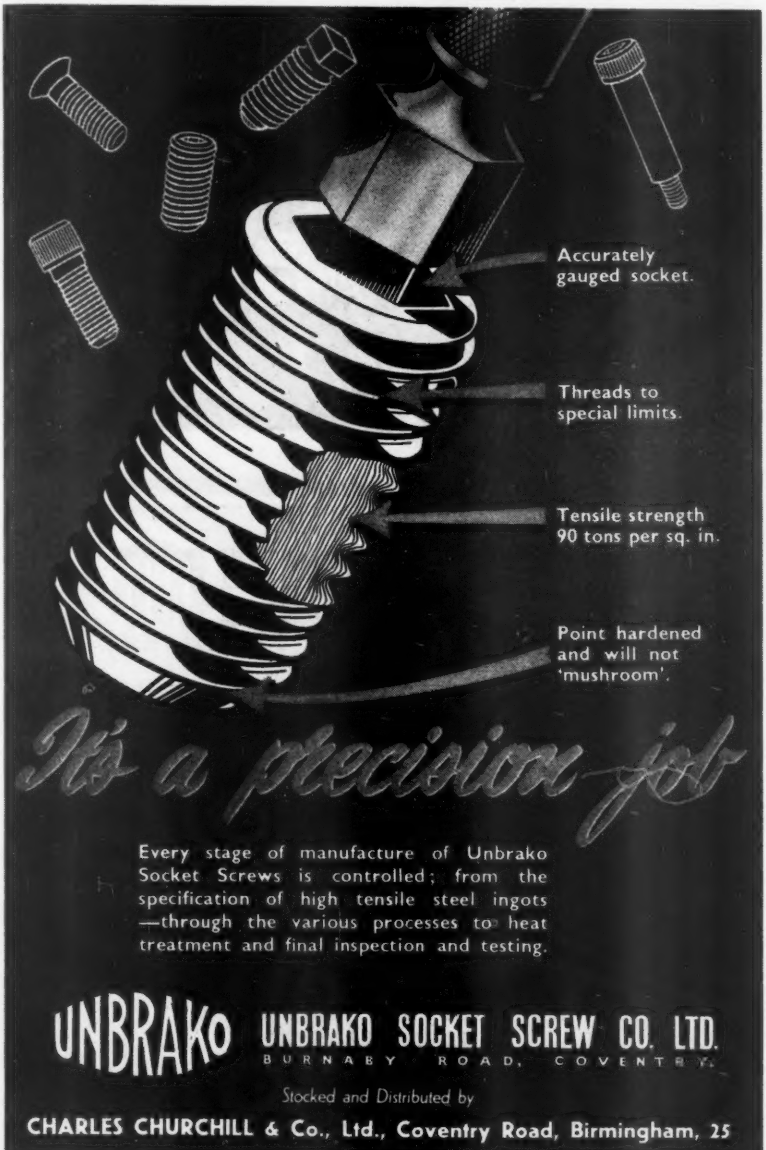
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The Council has for some time past conferred on those who have rendered the Institution long and distinguished service the title of Honorary Member.

At the present time, the Honorary Members of the Institution are :

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INSTITUTION NOTES

February, 1949

COUNCIL ELECTIONS 1949/50—NOMINATIONS

a) Members will appreciate that the vitality of the Institution depends entirely upon the ability and enthusiasm of those whom its members elect to Council. It is important therefore that every corporate member gives this matter his utmost thought during the forthcoming election.

b) In addition to Officers and Section representatives, Council includes twelve Elected members of whom two must be Associate Members. In accordance with Articles of Association 44 and 45, of these twelve members the six who have been longest in office since the date of their last election retire annually, but they may seek re-election.

c) In accordance with Article 49, nominations are now invited to fill six vacancies for Elected members to serve on Council for 1949/50, (five Members and one Associate Member).

d) Candidates for election must be nominated in writing by three Members or Associate Members of the Institution, nominations to reach Head Office by not later than 15th March, 1949.

e) In addition to nominations as at (d), each Section Committee may nominate one candidate.

f) The following are the six members who will retire in 1949 (see para. (b)) and are eligible for re-election. **No nomination** is required in respect of any of these gentlemen. This exception to the rule is provided for in Article 49.

1. Mr. R. M. Buckle, M.I.P.E.
2. Mr. L. R. Evans, M.I.P.E.
3. Mr. R. C. Fenton, M.I.P.E.
4. Mr. W. V. Hodgson, M.I.P.E.
5. Mr. M. H. Taylor, M.I.P.E.
6. Mr. S. Wright, M.I.P.E.

TECHNICAL EDUCATION A vacancy exists for a Senior Lecturer in Production Engineering (Machine Tools and Jig and Tool Practice) in the Department of Aircraft Economics and Production of the College of Aeronautics. Applicants should be fully trained engineers, preferably with B.Sc. degree or equivalent in Mechanical Engineering, with considerable knowledge of the design,

manufacture and operation of machine tools, and of jigging and tooling in the light engineering industry. Specialised experience in the aircraft, aero-engine or other precision engineering branches is desirable. Experience in teaching these subjects is desirable, but not absolutely essential.

Full particulars may be obtained from The Registrar, The College of Aeronautics, Cranfield, Bletchley, Bucks.

GRADUATESHIP EXAMINATION, 1949

1. The Graduateship Examination of the Institution of Production Engineers will be held on Friday and Saturday, April 29th and 30th, 1949.

2. Examination Entry Forms, which are obtainable from the Head Office of the Institution, must be despatched *so as to reach the Head Office by not later than the 18th March, 1949*, and must be accompanied by an entrance fee of ten shillings.

3. No entry will be accepted unless accompanied by a Form of Application for Junior Membership.

4. Candidates must be under 28 years of age.

5. Rules and Syllabus and copies of past two years Examination Papers may be obtained from the Head Office (price 3d. per set).

6. Full details of the Examination will be sent to every candidate.

FORMATION OF DISCUSSION GROUP

A Discussion Group has recently been formed by the Wolverhampton Graduate Section, for the purpose of holding informal discussions on all aspects of Production Engineering, with special reference to its effect on members of the Section.

These Discussion Meetings will be held in addition to the normal lecture meetings and works visits.

NEWS OF MEMBERS

Mr. E. G. Gilberthorpe, A.M.I.P.E. is now Works Manager of S. M. Wilmot & Co. Ltd., Bristol.

Mr. B. G. L. Jackman, M.I.P.E. is now Works Director of British Heat-Resisting Glass Co., Bilston.

Mr. S. R. Kay, Grad.I.P.E. has been appointed Mechanical and Electrical Superintendent to the City of Coventry Gas Department.

Mr. W. G. Middleton, A.M.I.P.E. is now Assistant Manager at the Royal Ordnance Factory, Woolwich.

OBITUARY

The Institution deeply regrets to announce the deaths of Mr. T. White, M.I.P.E., and Mr. T. S. G. Neville, A.M.I.P.E., both of Glasgow Section, and Mr. D. V. Gallon, Grad.I.P.E. of Yorkshire Section.

ISSUE OF JOURNAL TO NEW MEMBERS Owing to the fact that output has to be adjusted to meet requirements, and in order to avoid carrying heavy stocks, it has been decided that the Journal will only be issued to new Members from the date they join the Institution.

IMPORTANT In order that the Journal may be despatched on time, it is essential that copy should reach the Head Office of the Institution not later than 40 days prior to the date of issue, which is the first of each month.

SECTION MEETINGS

The following meetings have been arranged to take place in February and March, 1949. Where full details are not given, these have not been received at the time of going to press.

February

2nd LIVERPOOL SECTION. An informal discussion between Members only will be held at the Exchange Hotel, at 7-15 p.m.

2nd NOTTINGHAM SECTION. A lecture on " Purchasing to Schedule " will be given at the Victoria Station Hotel, Nottingham, at 7-00 p.m.

2nd PRESTON SECTION. A lecture on " Mechanical Mishaps and Their Relation to Design and Workmanship " will be given by Mr. G. E. Windeler, M.I.Mech.E., M.I.Mar. E., M.Consulting E., at Clayton Goodfellow & Co. Ltd., Blackburn.

2nd WOLVERHAMPTON SECTION. A lecture on " Production of Fine Surface Finishes " will be given by Mr. H. W. Lawton, A.M.I.Mech.E., Grad.I.P.E., at the Dudley and Staffs Technical College.

3rd GLASGOW SECTION. An informal discussion on " Improved Production Methods and Management " will be held at the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, at 8-00 p.m.

4th WEST WALES SUB-SECTION. A lecture on " The Production of Steel Sheets " will be given by Mr. H. H. Stanley, A.M.I.P.E., at the British Iron and Steel Research Association Laboratory, Sketty Hall, Swansea, at 7-30 p.m.

5th YORKSHIRE GRADUATE SECTION. A visit will take place to Messrs. Phelon & Moore, Ltd., Cleckheaton, at 10-00 a.m.

7th YORKSHIRE SECTION. A lecture on " Die Casting " will be given by Dr. Street at the Hotel Metropole, Leeds.

February—*cont.*

8th COVENTRY GRADUATE SECTION. A lecture on "Some Aspects of American Production" will be given by Mr. D. Burgess, M.I.P.E., in Room A5, Technical College, Coventry, at 7-15 p.m.

8th BIRMINGHAM GRADUATE SECTION. A lecture on "Generation of Fine Finishes by Machining Techniques" will be given by Mr. P. Spear, B.Eng., Grad.I.P.E., at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 7-00 p.m.

9th SHEFFIELD SECTION. A lecture on "Cutlery Manufacture" will be given by Mr. E. Allen at the Royal Victoria Station Hotel, Sheffield, at 6-30 p.m.

9th WESTERN SECTION. A lecture on "Induction Heating" will be given by Mr. W. J. G. Cosgrave, B.Sc., A.I.M., at the Grand Hotel, Bristol, at 7-15 p.m.

9th MANCHESTER SECTION. A visit will take place to the Oil Well Engineering Co. Ltd., Cheadle Heath, Stockport, at 2-15 p.m.

9th LUTON GRADUATE SECTION. A lecture on "Die-casting" will be given by Mr. R. W. Bailey, M.A., B.Sc. (Oxon.), at the Town Hall, Luton, at 7-30 p.m.

10th BIRMINGHAM SECTION. An afternoon visit will take place to the Standard Motor Co., Ltd., Tractor Plant.

10th CORNWALL SECTION. A lecture on "Electronics in Industry" will be given by Dr. E. J. B. Willey, at Holman's Canteen, Dolcoath Road, Camborne, at 7-15 p.m.

11th WESTERN SECTION. A lecture on "Jig and Tool Design" will be given by Mr. R. O. Jeakings, at Wheatstone Hall, Brunswick Road, Gloucester, at 7-30 p.m.

11th EASTERN COUNTIES SECTION. A discussion on "The Position of the Production Engineer in Relation to National Economy" will be held at the Lecture Hall, Electric House, Ipswich, at 7-15 p.m.

11th WOLVERHAMPTON SECTION. A lecture on "Metallurgy" will be given by Dr. T. Wright at the Wolverhampton and Staffs Technical College, at 7-15 p.m.

11th COVENTRY SECTION. A lecture on "Broaching—Machines, Tools and Practice" will be given by Mr. E. Percy Edwards, M.I.P.E., in Greyfriars Room, Geisha Cafe, Coventry, at 7-00 p.m.

11th LONDON SECTION. A visit will take place to Messrs. Harris Lebus Ltd.—Manufacturers of Furniture—at 2-30 p.m.

February—*cont.*

14th HALIFAX SECTION. A lecture on "Development in High Frequency Heating of Metals" will be given by Mr. T. G. Tanner at Whiteley's Cafe, Westgate, Huddersfield, at 7-00 p.m.

16th EDINBURGH SECTION. A lecture on "The Education of the Production Engineer" will be given by Mr. T. B. Worth, M.I.P.E., A.M.I.Mech.E., A.M.I.E.E., at the North British Station Hotel, Edinburgh, at 7-30 p.m.

16th LIVERPOOL SECTION. A lecture on "Education for Management" will be given by Lt.Col. Urwick, O.B.E., M.C., M.A., C.I.Mech.E., M.I.P.E., F.I.I.A., at Radiant House, Bold Street, Liverpool, at 7-15 p.m.

16th BIRMINGHAM SECTION. A lecture on "Recent Developments in the Glass Industry" will be given by Sir Hugh Chance at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 7-00 p.m.

17th GLASGOW SECTION. A lecture on "Valid Incentives" will be given by Mr. E. C. Gordon England, M.I.P.E., F.R.Ae.S., F.I.I.A., at the Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, at 7-30 p.m.

17th LEICESTER SECTION. A lecture on "The Application of Colour in Factories" will be given by Mr. Neville Sykes, A.M.I.Mech.E., A.M.I.E.E., in Room 104, Leicester College of Technology, The Newarkes, Leicester.

17th LONDON SECTION. A lecture on "The Development of Electronic Equipment" will be given by Mr. J. L. Thompson, M.Brit.I.R.E., and a lecture on "The Electronic Control of Machine Tools" will be given by Mr. S. A. Ghalib, B.Sc., A.M.I.E.E., at a joint meeting between the British Institute of Radio Engineers and the Institution of Production Engineers, in the Assembly Hall, Royal Empire Society, Northumberland Avenue, W.C.2 (Craven Street entrance), at 7-00 p.m.

18th NORTH EASTERN GRADUATE SECTION. A lecture on "Jig and Tool Design" will be given by Mr. M. Davidson at Neville Hall, Newcastle-on-Tyne, at 6-30 p.m.

19th MANCHESTER SECTION. A lecture on "The Production Engineer—His Education and Training" will be given by Mr. T. B. Worth, M.I.P.E., A.M.I.Mech.E., A.M.I.E.E., at the Mechanics Institute, Crewe.

February—*cont.*

19th YORKSHIRE GRADUATE SECTION. Some Short Papers will be given at the Midland Hotel, Bradford, at 2-30 p.m.

21st MANCHESTER SECTION. A lecture on " The Position of the Production Engineer in Relation to National Economy" will be given by Mr. T. S. Smith, B.Sc., M.I.Mech.E., M.I.P.E., at the Manchester College of Technology.

21st NORTH EASTERN SECTION. A lecture on " Air Operated Fixtures " will be given by Mr. N. P. Watts at Neville Hall, Newcastle-on-Tyne, at 6-30 p.m.

21st DERBY SUB-SECTION. A lecture on " Education of the Production Engineer " will be given by Mr. T. B. Worth, M.I.P.E., A.M.I.Mech.E., A.M.I.E.E., at the Art School, Green Lane, Derby, at 7-00 p.m.

22nd LUTON SECTION. A lecture on " One Aspect of Sand Casting " will be given by Mr. J. W. Gardom.

22nd LINCOLN SUB-SECTION. A joint meeting with Grantham Engineering Society who will hold a " Brains Trust " will take place at Aveling Barfords Canteen, at 7-45 p.m.

23rd MANCHESTER GRADUATE SECTION. A lecture on " The Manufacture of a Typewriter " will be given by Mr. R. N. Evans, in the Reynolds Hall, College of Technology, Manchester, at 7-15 p.m.

26th HALIFAX GRADUATE SECTION. The Annual General Meeting will be held at the White Swan Hotel, Halifax, followed by a film afternoon including the " Age of Precision " and " Highway to Production." The Meeting will commence at 2-00 p.m.

March

2nd NOTTINGHAM SECTION. The Annual General Meeting will take place at Victoria Station Hotel, Nottingham, at 7-00 p.m.

2nd PRESTON SECTION. A lecture on " Modern Surface Coating and Post War Synthetic Finishes " will be given by Mr. C. A. J. Taylor, M.Sc., A.R.I.C., at the Harris Institute, Preston.

2nd WOLVERHAMPTON SECTION. A lecture on " Colour Schemes for Factory and Machines " will be given by Mr. S. A. Wood, at the County Technical College, Wednesbury.

3rd GLASGOW SECTION. An informal discussion on " Developments in Production Engineering—Education " will be held at the Royal Technical College, Glasgow, at 7-30 p.m.

March—*cont.*

4th WEST WALES SUB-SECTION. An " Industrial Digest " evening will be held at the Technical College, Swansea, at 7-30 p.m.

5th YORKSHIRE GRADUATE SECTION. The Annual General Meeting, followed by a lecture on " Wire and its Application to Industry " given by Dr. R. Goodacre, B.Sc., will be held at the Great Northern Hotel, Leeds, at 2-15 p.m.

8th BIRMINGHAM GRADUATE SECTION. The Annual General Meeting will be held at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 7-00 p.m., when there will be an Address by the Chairman, Mr. J. D. Berry, Grad.I.P.E.

8th COVENTRY GRADUATE SECTION. A lecture on " Corby Iron and Steel Works of Stewarts and Lloyds Ltd." will be given by Mr. A Stirling, B.Sc., in Room A5, Technical College, Coventry, at 7-15 p.m.

8th MANCHESTER SECTION. A Works Visit to Manchester Oil Refinery Ltd., Trafford Park, Manchester, will take place at 2-00 p.m.

9th LUTON GRADUATE SECTION. A lecture on " Powder Metallurgy and the Engineer " (illustrated by slides) will be given by Mr. H. W. Greenwood at the Midland Hotel, Luton, at 7-00 p.m.

9th SHEFFIELD SECTION. A lecture on " Mass Production of a British Alarm Clock " will be given by Mr. E. S. Desmond at the Royal Victoria Station Hotel, Sheffield, at 6-30 p.m.

9th WESTERN SECTION. A lecture on " The Metallurgist's Place in Production Engineering " will be given by Mr. E. R. Gadd, F.I.M., at the Grand Hotel, Bristol, at 7-00 p.m.

11th EASTERN COUNTIES SECTION. A lecture on " Budgetary Control " will be given by Mr. B. B. Beaumont, in the Lecture Hall, Electric House, Ipswich, at 7-15 p.m., preceded by the Annual General Meeting at 6-00 p.m.

11th COVENTRY SECTION. A lecture on " Recent Developments in Automobile Gear Production " will be given by Dr. W. A. Tuplin, M.I.Mech.E., in Greyfriars Room, Geisha Cafe, Coventry, at 7-00 p.m.

12th COVENTRY GRADUATE SECTION. A Works Visit will take place to Stewarts & Lloyds Ltd., Corby.

14th HALIFAX SECTION. A lecture on " Mechanical Mishaps and their relation to Design and Workmanship," will be given by Mr. G. E. Windeler, M.I.Mech.E., M.I.Mar.E., at the White Swan Hotel, Halifax, at 7-00 p.m.

March—*cont.*

15th LINCOLN SECTION. The Annual General Meeting, followed by a lecture on "Management at the Crossroads" given by Mr. Lewis C. Ord, will take place at the Lincoln Technical College, at 7-15 p.m.

16th LIVERPOOL SECTION. A lecture on "Difficulties and Developments in Deep Drawing and Pressing" will be given by Dr. J. D. Jevons, B.Sc., F.R.I.C., F.I.M., at Radiant House, Bold Street, Liverpool, at 7-15 p.m.

16th EDINBURGH SECTION. A lecture on "Plastics in Engineering" will be given by Mr. F. T. Barwell, at the North British Station Hotel, Edinburgh, at 7-30 p.m.

16th BIRMINGHAM SECTION. The Annual General Meeting and a lecture on "Recent Developments in Grinding Practice" given by Mr. R. J. M. Whibley, A.M.I.Mech.E., will take place at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 7-00 p.m.

16th MANCHESTER GRADUATE SECTION. The Annual General Meeting and a lecture on "Costing in Relation to the Production Engineer" given by Mr. W. A. Eastwood, A.C.W.A., will take place at Reynolds Hall, College of Technology, Manchester, at 6-45 p.m.

16th MANCHESTER SECTION. A lecture on "Development and Application of all Branches of Resistance Welding" will be given by Mr. C. A. Burton at the Mechanics Institute, Crewe.

17th WESTERN SECTION. A lecture on "Design for Welding" will be given by Mr. F. Jukes, A.M.I.Mech.E., A.M.I.W., at Exeter.

17th GLASGOW SECTION. The Annual General Meeting, and a lecture on "Production Research in America" given by Dr. H. Orenstein, M.I.P.E., will take place at the Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, at 7-30 p.m.

17th LEICESTER SECTION. The Annual General Meeting, Section President's Address, and Films on a popular technical subject, will take place in Room 104, Leicester College of Technology, The Newarkes, Leicester.

18th NORTH EASTERN GRADUATE SECTION. A lecture on "Grinding" will be given by Mr. J. Stanniers at Neville Hall, Newcastle-on-Tyne, at 6-30 p.m.

21st MANCHESTER SECTION. A lecture on "Modern Alarm Clock Production" will be given by Mr. A. W. Marshall, at the Manchester College of Technology.

March—*cont.*

21st NORTH EASTERN SECTION. A lecture on " Noise and Vibration in Machinery " will be given by Dr. W. A. Tuplin, M.I.Mech.E., at Neville Hall, Newcastle-on-Tyne, at 6-30 p.m.

23rd WESTERN SECTION. The Annual General Meeting will be held at the Grand Hotel, Bristol, at 7-15 p.m.

24th LONDON SECTION. A lecture on " Pressure Welding " will be given by Mr. R. F. Tylecote, M.Sc., A.M.I.E.E., after the Annual General Meeting at the Assembly Hall, Royal Empire Society, Northumberland Avenue, W.C.2 (Craven Street Entrance), at 7-00 p.m.

25th COVENTRY SECTION. The Annual General Meeting will be held in Greyfriars Room, Geisha Cafe, Coventry, at 7-00 p.m.

26th BIRMINGHAM SECTION. The Section Annual Dinner and Dance will be held at the Botanical Gardens, Edgbaston.

26th YORKSHIRE GRADUATE SECTION. A Works Visit to Messrs. Price (Tailors) Ltd., Leeds, at 2-30 p.m. has been arranged.

28th DERBY SUB-SECTION. The Annual General Meeting, followed by a sound film " Precise Measurement for Engineers," will be held at the Art School, Green Lane, Derby, at 7-00 p.m.

30th HALIFAX GRADUATE SECTION. A lecture on " Metallurgical Factors Influencing the Machinability of Steels " will be given by Mr. L. W. Johnson, M.I.P.E., at the Technical College, Huddersfield, at 7-00 p.m.

MEASUREMENT OF PRODUCTION EFFICIENCY
ONE DAY CONFERENCE

A one-day Conference to discuss the measurement of production efficiency was held at the Royal Empire Society, London, on 5th November, 1948, by the Institution of Production Engineers and the Institute of Cost and Works Accountants. The Meeting was significant because of its coincidence with the preliminary talks of the Anglo-American Productivity Council, and was attended by Mr. Basil D. Dahl, Commercial Attaché, American Embassy. Other prominent guests were Sir Ewart Smith, of the F.B.I. Productivity Secretariat, Dr. Alexander King, a member of the Lord President's Committee on Industrial Productivity, and Sir Leonard Browett, Director-General of the National Union of Manufacturers.

In opening the proceedings, Mr. J. E. Hill, M.I.P.E., Chairman of Council of the Institution of Production Engineers, stated that the Conference was intended to be the forerunner to the establishment of principles of production measurement which could be commonly applied to the manufacture of a wide range of equipment and commodities.

The Chairman, Mr. B. H. Dyson, M.I.P.E., then called upon Mr. L. W. Robson, F.C.A., F.C.W.A., A.I.P.E., to give his address on " Measurement of Production Efficiency."

Mr. Robson drew attention to the remarkable lack of comparable statistical data upon which to base comparisons of the efficiency of firms within the same industry. The most disturbing factor was that with existing manpower and equipment the levels of output were considerably lower than could be attained. He stressed the importance of the functions of the industrial accountant in measuring productivity and the necessity of his close co-operation with the production engineer. It was only through such co-operation that vital control information could be compiled.

Mr. Robson felt sure that this approach to the problem of measurement of achievement, if adopted throughout British industry, would result in managements attaining substantially higher levels of output from existing capital equipment and man-power. There would be other advantages, such as the availability of operating costs for like processes within a particular industry in a comparable form.

Comparable product costs were obviously unsatisfactory for the purpose of measuring productivity and operating costs for individual

processes, as a product cost embraced all costs, and there was the added complication of the widely varying quality and design of what was basically the same product of a particular industry.

Mr. Robson concluded by recommending :

(*a*) That the activities of individual research committees of professional bodies concerned with the technical and financial measurement of productivity should be co-ordinated.

(*b*) That the best-known procedures in evaluating productivity for industrial processes in terms of hours of output and cost should be studied and reduced to a form intelligible to management.

(*c*) That such information should be placed in the hands of all concerned with the problem of improving industrial productivity, namely individual managements, trade associations, the executives of nationalised enterprises, and the appropriate Government departments.

Contributions to the ensuing discussion were made by Mr. T. W. Delury, A.C.W.A., Mr. Mark Taylor, M.I.P.E. (Leicester), Mr. T. H. Nicholson, F.C.W.A., Mr. L. A. Crawley, A.I.P.E. (London), Mr. R. Appleby, M.I.P.E. (London), Mr. G. E. Bateson, A.M.I.P.E. (Birmingham), Mr. Hauxwell, A.C.W.A. (London), Mr. J. W. Buckley, M.I.P.E. (Luton), and Mr. J. Vaughan, M.I.P.E. (S. Wales).

At the afternoon session, which was opened by Mr. George Stone, F.C.W.A., President of the Institute of Cost and Works Accountants, Mr. W. C. Puckey, M.I.P.E., F.I.I.A., presented a paper on "Measurement and Management." In his opening remarks he emphasised that the success of any enterprise depended on detailed planning—that was the essence of good management. It was essential that managers should be conversant with contemporary developments and standards, and to this end they should make every effort to know the facts.

The Production Engineer should constantly check his achievements against the best of his class at home and abroad, and should always be ready to put into operation new productive ideas. The Departmental Supervisor should concentrate on machine utilisation, job and merit rating, output and quality and see that the workers are aware of his objectives. The Personnel Officer's job was to supply precise and graphic statistics to line supervisors, and establish his standards by comparison with the methods of other companies and other countries. The Cost Accountant should remember that quality and simplicity of statistics were more important than quantity, and should utilise more fully costs based on Standards and Quality Control methods. The same standards of comparison should be set on overheads as on direct labour.

The Time Study Man should furnish management with concise trend figures and stress motion study as well as time study. The

Chief Designer should regularly compare competitive articles from both home and abroad with his own designs, and should see that such analyses reach the Production Engineer.

The Factory Manager should compare the American rate of production, which was 2.2 to 1 over this country, with his own, and attempt at least to equal it. He should capitalise on the special spurt imposed on his own organisation in emergency, and should ensure that the workers were aware of his standards of expectancy.

In the distributive field, the cost of lifting and shifting, packing and dispatching, all added much to factory costs, and it was the Distribution Manager's contribution to attempt to reduce this cost.

Finally, as men liked to work for an efficient organisation, it was the Directors' job to foster a feeling of pride in the concern, and make known as many simple facts about the business as were required.

In conclusion, Mr. Puckey stated that there was no easy road to success in setting standards of performance. The manager had to consider how few really effective figures were necessary in order to control his business efficiently.

During the ensuing discussion, Mr. G. R. Pryor, M.I.P.E. (Sheffield), contended that an immediate contribution to production could be made by smaller firms, if they had the facilities for operational research available to larger concerns. Mr. Pryor suggested that a voluntary Development Panel might be formed in every important centre, with a permanent staff of skilled men who would help the small firms with their problems. He felt that the Government could well be asked for financial assistance to put this plan into action.

Contributions to the discussion were also made by Mr. C. M. McBean, A.C.W.A. (Coventry), Mr. J. McFarlane, M.I.P.E. (Glasgow), Mr. S. R. Howes, M.I.P.E. (Sheffield), Mr. E. A. Corbett, A.C.W.A. (Birmingham), Mr. H. N. Tennant, A.C.W.A. (Birmingham), Mr. W. Coutts-Donald, F.C.W.A. (London), Mr. H. P. Sanderson, A.M.I.P.E. (S. Wales), Mr. C. H. T. Williams, M.I.P.E. (Sheffield), Mr. E. Gordon England, M.I.P.E. (London), Mr. C. J. Luby, M.I.P.E. (Bristol), Mr. G. Witton, A.M.I.P.E. (London), Mr. C. G. S. Jennings, F.C.W.A., Mr. I. C. Green, M.I.P.E. (Glasgow), Mr. R. Warwick Dobson, F.C.W.A. (London), and Mr. R. Hutcheson, A.I.P.E. (London).

In summing up the Chairman said that possibly the main overall function of the research to be carried out by the Institution of Production Engineers and the Institute of Cost and Works Accountants was to find out how to simplify the facts, and subsequently put them into operation. It was management's job at all levels to use the tools at their disposal. A financial budget for the non-producing departments was possibly one of the most important

managerial targets. The review of actual expenditure was often made too late—more action should be taken in the earlier stages. As financial statements were apt to be misleading, it was important that a true standard should be used whenever possible. One of the biggest problems was how to open the " closed shop " of information, of interchange of technical costing, and of organisation functions.

It was also vital that management should determine its standards of expectancy before going into production. The problem of obtaining so much production per man hour had now changed to production per man hour at how much quality and how much cost—both factors which could be measured and were results of measurement.

Finally, the Chairman said that two main objectives had been defined as a result of the Conference—first, all those present should make it their business to propagate the fact that measurement of productivity must result in increased efficiency ; this could best be done by example. Second, both the Institution of Production Engineers and the Institute of Cost and Works Accountants should base their further investigations on the carrying out of research on individual and industrial process operations, in order to establish a simple standard which could be used to measure difficult problems in industry.

Since this Conference was held, a Joint Committee has been set up in conjunction with the Institute of Cost and Works Accountants to devise the best means of measuring comparative productivity, and to discover methods of applying these measures for the purpose of increasing productivity. The members of this Joint Committee are :

Institution of Production Engineers :

Mr. W. C. Puckey (Joint Chairman), Mr. H. W. Bowen, Mr. B. H. Dyson.

Institute of Cost and Works Accountants :

Mr. L. W. Robson (Joint Chairman), Mr. R. W. Dobson, Mr. I. Morrow.

MEMORANDUM ON METHODS EMPLOYED TO ACHIEVE ECONOMY IN THE USE OF FUEL

As a result of a survey recently carried out by the Institution of Production Engineers in collaboration with its affiliated firms, with the object of ascertaining the effect on productivity of various methods employed to reduce consumption of fuel and power, the following observations are put forward.

The principal methods employed last winter were as follows :—

(1) Staggered hours.

(2) Transfer of equipment with heavy power consumption to night shifts.

(3) Use of private generating plants.

(4) Installation of power factor correction capacitators.

(5) Economy in fuel for space heating.

These methods were used both singly and in combination.

STAGGERED HOURS During the winter of 1947/48 approximately 25% of the firms who co-operated in this survey introduced some form of staggered hours. Although the necessary load-shedding was achieved, the majority of firms using this method stated that it had resulted in loss of production and increased costs. It also caused a considerable amount of unrest amongst labour, particularly amongst employees above the age of 60, and the incidence of sickness and absenteeism rose fairly heavily. Moreover, the staggered hours resulted not only in loss of production but in deterioration of quality.

NIGHT SHIFTS A number of firms adopted with success a scheme whereby certain machine tools, furnaces or equipment using a considerable amount of power in relation to other machines, were used only on night shift. This method was very satisfactory, although it would not be suitable for every type of firm. In some companies this system of working was carried out by volunteers, whilst in others, particularly attractive terms had to be offered to the operators to induce them to transfer to permanent night shift for the winter months. This scheme had the merit of inconveniencing as few of the workpeople as possible, while the main body of the works carried on under normal conditions. In some cases, load-shedding during the day was found to be necessary in addition to these measures.

USE OF PRIVATE GENERATING PLANT

(*a*) *Generators.*

During last winter, approximately 35% of the firms covered by the survey already possessed their own generating plant or purchased it to supplement the public supply. For the coming winter of 1948/49, this percentage has been greatly increased, and is now approximately 50%.

In several cases, generators were employed in conjunction with other methods such as strict economy in space heating at peak periods. The full saving was achieved without adversely affecting production.

(*b*) *Use of Fordson Tractors.*

For small factories, it is worth while to mention the experiment of one firm who used continually, during the fuel economy period from 1st October until the end of March, four Fordson Major Tractors which were driven without any difficulty into line with the shafting and the drive taken from the Fordson power take-off. These Fordsons gave a consistent output of 30 h.p., the four machines giving a total output of 120 h.p. Incidentally, these tractors gave complete trouble-free service 44 hours per week over a period of six months. This would appear to be an ideal solution in circumstances where it can be operated.

INSTALLATION OF POWER FACTOR CORRECTION CAPACITATORS

A great saving can also be introduced by means of power factor correction capacitators. It is well known that alternating current apparatus takes from the line far more current than it uses, and if efficiency is to be obtained this flow of extra current must be eliminated. The installation of these capacitators generally produces a large saving, with no loss of production, and it is suggested that careful consideration should be given to the possibility of installing such equipment in all factories.

GENERAL COMMENTS

The opinion was expressed by some firms that alternative schemes cannot be run satisfactorily in the same town. The employees do not understand why some firms can work normal hours whilst others cannot, and draw the conclusion that there is lack of ingenuity on the part of management; consequently, they feel resentment, and their output and its quality both suffer.

These misunderstandings could no doubt be corrected if fuller explanations concerning the operation of such schemes were given to the workpeople.

It is felt that individual firms should be allowed to adopt the most efficient means available for carrying out the necessary fuel and

power saving in their own particular case and the Regional Boards should undertake the necessary propaganda to convince the work-people of the need for such measures.

In putting forward this Memorandum, it is hoped that these observations may be of some value in assisting firms to effect the necessary savings without loss of production.

BALL AND ROLLER BEARINGS

by J. E. BATY, M.I.P.E.,
(Chairman, Standards Committee).

The subject of the assembly tolerances of ball and roller bearings has been raised recently at Finance and General Purpose Committee meetings and also at a Council meeting. The matter has been referred to the Standards Committee of the Institution for consideration. It is felt that this is a problem production engineers should be in a better position to deal with than anyone else and every member is urged to help by writing to Headquarters on this subject. If you use ball or roller bearings your mind is probably made up on the points raised below, and all we ask for is a paragraph stating your views.

There does not appear to be any criticism of the tolerances laid down in B.S. 292-1927 for eccentricity or 'wobble,' but some criticism has been raised on the magnitude of the tolerances for the 'Bore' and 'Outside Diameter' in this specification.

There are certain applications of rolling bearings which require very special tolerances—such as aero-engines and the finer classes of machine tools—but these for the time being may be considered as special cases. Your Standards Committee is desirous of finding if the diametral tolerances laid down in the existing specification fulfil the general requirements of industry.

Two main criticisms have been advanced :—

(*a*) Tolerances are too wide for interchangeability.

(*b*) The finely graded clearances between the balls (or rollers) and the raceway may be seriously interfered with if too tight a fit is obtained on assembly, and the proper performance of the bearing would thus be impaired.

Of course a tightening of the tolerances for ball and roller bearings would involve equally close tolerances for bearing housings and shafts on which they must fit.

It should be stated that any tightening up of tolerances for ball and roller bearings would be a matter for the future due to the present acute shortage, but it is desirable to get the opinion of industry now so that whatever investigations are necessary may be put in hand with the view of revising the specification, should that course be found desirable.

The Standards Committee would be glad to have information from members who use ball or roller bearings in their manufactures, saying whether or not they consider bearings, as at present made to B.S. 292, are satisfactory for general requirements. If you have suggestions to make as to appropriate tolerances for this class of bearings the Standards Committee will be glad to have them, but our main concern at present is to get a consensus of opinion on the present rolling bearing tolerances. With your opinion please state on what machines or apparatus you use such bearings.

ALUMINIUM ALLOY GRAVITY DIE CASTINGS AS AFFECTING THE PRODUCTION ENGINEER

by H. C. CROSS.*

Presented to the London Graduate Section of the Institution, March 9th, 1948.

In preparing this paper on the manufacture of aluminium alloy gravity die castings, I had in mind not so much the technical aspect of producing these castings, but rather the idea of giving Production Engineer, Designer and Buyer a general review of practical manufacture, and problems which confront the foundry in supplying a satisfactory article to meet the requirements of the customer in every way. This means that the casting must fulfil in the most efficient manner, the job for which it is intended, and the aluminium alloy which is selected must be suitable for the particular application desired. The price of the casting is not so much controlled by the value of the material as the labour expended in producing it, overhead charges generally being directly associated with the direct labour costs. In these days when higher production is so necessary and is being stressed all round, various ways and means are being devised to achieve it and team work is vital to obtain the best results. This is why it is so essential for the Foundry Engineer, Production Engineer, and Designer to work together in the early stages, in order to ensure that ;

(1) the article produced is simple in design from the foundry angle, so that a sound casting can be made at an economical price by modern foundry methods.

(2) the minimum of machining and additional work is expended.

(3) the casting is efficient in its phase of application.

The advice of the Foundry Engineer, who has specialised knowledge of the alloys through constant use and experience, can be of considerable help as the material selected has a special bearing on the die design and the subsequent production of the casting. The design of the casting is also important, for soundness and ease of manufacture. Foundry work is a specialised job, with a multitude of problems arising from day to day, and if it is possible for this co-operation to be obtained, each man seeing the other's point of view and meeting him in his problems, the tendency will be to promote general good feeling and efficiency. In most cases it will be found

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that a suitable compromise can be reached which is acceptable to all concerned, and this will have a most beneficial effect on production and the subsequent price of the finished article. I propose, therefore, to go through the various phases of manufacture from the time the initial drawings are produced until the finished casting is made.

Whilst this paper is dealing primarily with aluminium gravity die castings, it is just as well to compare these with sand and pressure die castings, so that we have it clear in our minds that the gravity die method is the most suitable one for the casting concerned. Selection of the material, simple points of design, and die design will also be dealt with, together with inspection and final finishing.

Foundry work is very interesting and valuable information can be obtained from a visit to see actual castings produced. However, it is perhaps better to have some idea of the process in the first place and if I can bring to light some of the problems with which the foundry is faced, and by doing so achieve the interest and co-operation of the Designers and Production Engineers, I shall feel that this paper has been well worth while.

At this stage I think we will now proceed to consider the relative position of gravity die castings as compared with other methods of manufacture.

SAND CASTINGS

The manufacture of commercial sand castings is normally considered to be the least complicated of the three forms, the general equipment required being of a simpler type. It consists of the necessary moulding boxes and parts, chains, hoisting tackle, patterns, coreboxes, the necessary sand and the furnace in which to melt the alloy ingot. For this reason there are endless small firms dotted about the country who can supply small quantities of castings at reasonable prices. Many of the very large companies in existence to-day started in a small way and have become modernised to a very high degree, their technical skill and scope developing at the same time. With this comes the ability to manufacture complex castings in higher grade materials where in conjunction with the laboratory, chemical and spectographic analysis, and technical apparatus such as microscopes and X-ray can be used in conjunction with foundry technique to produce very high quality castings.

It is necessary to make a separate mould each time the casting is made ; this is destroyed upon knocking out the casting. Even so the use of sand castings is very extensive in the engineering and general industries and the total output as regards weight is far in excess of gravity die castings and pressure castings. It is usually necessary when preparing prototypes to have the first few made in

sand so as to stabilise the designs, before considering large quantities. The casting technique in sand is rather easily adjusted as the founder has a large choice in the location of his gates and feeders so as to give a progressive solidification to the casting. Where these are not adequate, metal chills can be introduced into the mould to cool off quickly heavy sections which cannot be conveniently reached with feeders. Complicated cores can be used which will produce bosses and webs from which a simple metal core cannot be extracted, owing to extensive undercuts. Modifications can be quickly carried out to pattern equipment should last-minute alterations be required. The question of the size of the casting also is not limited, providing the foundry has the necessary lifting tackle, moulding boxes, core drying capacity and furnace capacity to suit. It is necessary for this larger intricate work to employ fully skilled men and the output per man hour is smaller than in the case of die castings. In a modern sand foundry, however, a high degree of mechanisation is being instituted and high production rates of medium sized castings can be produced with semi-skilled men on moulding machines using specially laid out patterns.

The standard of accuracy is also higher and the castings dimensionally more uniform than those that are hand made. This is due to the fact that there is no need for rapping, which tends to make the castings oversized and vary slightly from one to the other. Even so, neither the finish nor the accuracy is equal to that of gravity die or pressure die castings. Machining allowances, therefore, have to be increased to allow the castings to clean up to finished drawing dimensions. Greater care also has to be taken with the locations when using jigs and tools. Generally speaking, it is advisable to locate off a moulded portion, which is more consistent owing to the fact that cores are apt to vary slightly in their location in the sand mould, thus producing varying wall thicknesses.

Sand castings can be produced more speedily as the time in preparing the patterns would, on the average, be about one-third of that taken for dies, and after approval of the sample casting, production could be commenced within a few days.

To sum up, therefore, the use of sand castings is advised :

(1) for prototype and experimental work and the manufacture of small quantities where the cost of expensive dies, spread over this number, would be uneconomical—the cost of the pattern equipment being very much lower.

(2) where castings, by virtue of their large size or complicated internal design, are not suitable for economical production by the gravity die or pressure method.

(3) where the alloy required cannot be die cast satisfactorily owing to lack of fluidity or hot shortness as for some of the high strength materials; also where sand cores would have to be used to produce very complicated internal shapes from which the core gases could not easily escape if enclosed in a die.

PRESSURE DIE CASTINGS

This method has much to recommend it when very large quantities of accurate castings are required. The finish is very good and owing to the high pressures which force the metal into the die, has very sharp delineation.

It is most useful in the case where fine lettering, trade marks, etc., are required on the casting. To achieve this, the dies have to be machined very accurately so that there is no leakage between joint faces, and the finish has to be exceptionally fine otherwise tool marks, etc., would be revealed on the surface of the casting.

Fettling costs would be reduced to the minimum as very fine gates can be used owing to the high pressures utilised. These small gates can be cleaned off quite easily without damaging the appearance of the casting. The joint faces can also be cast very flat and true if no machining is required, and where holes can be cast within the extraction compass of the machine, these are sharp and need less taper than in the case of gravity die casting.

The smooth finish obtained greatly assists in the final finishing of the casting, especially in the case of zinc base pressure castings which can be plated directly on to the casting, e.g., a car door handle. The castings must be fairly simple in design without multi-piece cores, and the design generally must be such that the die can be opened mechanically and the casting ejected. The sections must also be uniform, otherwise shrinkage and general unsoundness can be expected in the heavy sections. The castings are not as strong as gravity castings, owing to the gates being small and cut off being instantaneous; the solidification is not as progressive as it is in gravity castings, where the feeders are kept alive by hot metals which feed the casting as it gradually cools—the reduction of volume between liquid and solid being in the region of seven per cent.

The size of the casting produced is somewhat limited by machine size and the high pressures per square inch required. The dies also are very costly to make owing to the expensive steels necessary to withstand the high friction caused by the ingress of the metal, and also to the additional cost of machining these materials and

the high grade of accuracy necessary to make them leak-proof. The chief points, therefore, to bear in mind when considering this process are :—

(1) whether the quantity is sufficiently large to justify the expense of dies.
(2) whether the casting, by virtue of its simplicity in design, is suitable for production by this process.
(3) whether the mechanical consideration or soundness required is acceptable.
(4) whether the advantages gained in elimination of machining and ease of finishing are a prime consideration.

GRAVITY DIE CASTINGS

This method of manufacture is very popular and one that is used extensively in the automobile, electrical, general engineering and allied trades, and seems to fill a large sphere of application between the fields of sand and pressure die casting.

As the name implies, the hot metal is fed into the cast iron or steel collapsible mould by its own weight and is allowed to solidify. The mould or die is then opened either by levers or mechanical means and the casting extracted. The operation is rather slower than the pressure die or machine operated die, particularly owing to the fact that the freezing time takes longer, the metal being hotter and the feeders larger. The casting produced, however, is stronger and of a denser structure than sand and pressure castings, owing to the chilling effect of the die and the feed back from the risers, which gives a more progressive solidification.

The finish of the casting, while not normally as good and sharp as a pressure die casting, is infinitely superior to a sand casting and a high grade of accuracy can be maintained within reasonable limits. In comparison with sand castings the machining can be very much reduced and where necessary cut down to the lowest minimum. The castings can be located in jigs more accurately owing to a higher overall dimensional accuracy.

In these days, when it is necessary to conserve vital machining capacity, an accurately made die casting is a very useful ally as it can be made with no machining on the joint face when washers are used, and bolt holes can be satisfactorily included if not too small. Brass or steel bushes, steel tubes, or other items which would normally have to be pressed or screwed into place, can be satisfactorily cast into the casting.

SELECTION OF MATERIAL

Aluminium castings is a very broad term used to denote that castings are made in an aluminium base material ; it is not generally realised by the layman that very few of the castings are made in pure aluminium. This is mainly due to the fact that aluminium is very difficult to cast

owing to its lack of fluidity and high shrinkage properties, which cause bad cracking. In any case it has very little to recommend it, although it has high electrical conductivity and good anodising and colouring qualities. In the cast form its strength is very low and it is very soft. It is usually alloyed with other elements such as copper, silicon, magnesium, manganese, zinc, etc., which considerably improves its physical properties and presents it in a more suitable casting form.

There is no end to the combinations of alloys which can be made and a very small difference in the quantity or variety of the alloying agents will considerably alter the properties. Special research work, however, has been carried out and is still proceeding, and certain alloys have been evolved for general and special purposes. These are covered by a series of specifications issued by the British Standards Institution, BSS, and the Director of Technical Development, DTD. These specifications are the ones normally used. The foundries are anxious not to increase the number of alloys used owing to the furnace capacity which would be required, but to reduce wherever possible. When selecting an alloy, therefore, it is advisable to give alternative specifications, especially where the higher grade materials are required such as for aircraft. There are a number in a group such as DTD.298, DTD.300 and DTD.304, where the foundry would like to select the particular alloy which is in constant use, as it is not economical to make melts in special materials for small runs. In selecting the alloy it is advisable first to consult the specifications for the secondary alloys, as these are made from scrap material readily available and are economical in price. They also comply to definite standards and are much used in foundries for general purpose work. It would not be possible, of course, in the confines of this paper to deal with all types of alloys, but a few of the more important ones are given at the end of this section.

It would be as well to mention that in considering the strengths of the alloy selected it should be borne in mind that standard specification test bar figures are not always what can be expected in the final casting. Test bars are uniform in section and are poured under ideal conditions into specially designed sand moulds ; in the circumstances this could not be attained on a normal casting in the foundry, owing to its differing sections and shape which cannot be fed so adequately or crystallise so progressively. Whilst the die casting being chilled would tend to be superior to sand castings, it does depend on the uniformity of the section as to whether chill-cast or even sand-cast test bar figures would be realised. The reason, of course, for taking a test bar is to prove that the material used is consistent from one batch to another, conforms to a definite

analysis and that heat treatment, if called for, has been carried out properly, so that the maximum physical characteristics will be achieved in the castings as compared with the test bar figures.

If the casting is highly stressed it will be necessary to choose a heat-treatable alloy of the high purity class, as the introduction of impurities will tend to reduce the strength and ductility which would be vital in the case of aircraft castings, where the Designer is out to save as much weight as possible. This obviously must be taken into consideration in the price charged for the casting. The writer has known instances when castings have been type tested and the factor of safety called for has been more than doubled. A lower strength material could have been used in this case without increasing the weight and at a very much more economical price. It is far better at times to use a moderate strength alloy from which a sound casting can be produced, than an alloy which is difficult to cast, has a tendency to crack, and on which there is a considerable amount of scrap in the Foundry and Inspection Department.

Whilst under ideal conditions a superior casting may be achieved which will give slightly higher strength, the cost is sometimes excessive. The selection of material for a certain purpose does, therefore, have to be considered together with the design of the casting as a whole, as the die design is also affected, especially in the case of materials which are ' hot short.' This term applies to certain alloys which, at elevated temperatures in the die, are mechanically weak just below solidification point, setting up strains in cooling in the mould and tending to tear and crack. Sometimes these cracks are internal and cannot be detected by ordinary means and special methods such as X-ray have to be adopted. This will be dealt with later in the paper.

Modifications to design can in some instances materially affect the result and require the co-operation of the foundry technician at the outset. It is generally a bad practice to change alloys when the dies and tools have been specially made, as would be the case if it was contemplated to change from a general purpose material to an alloy of the high strength class. The whole design of the casting and die would have to be reconsidered and it might be necessary to scrap the die and make another. Alloys can roughly be assumed to fall into three main groups :

(1) those used for general and commercial purposes in the automobile, electrical and general engineering industries.

(2) those possessing good corrosion resisting properties.

(3) the high-purity high-strength alloys such as are specified for aircraft and other vital jobs.

A few of the more popular alloys are listed below together with their chief constituents, physical properties, general characteristics and their suitability for various applications.

GENERAL PURPOSE ALLOYS

Spec.	*Approx. Composition*	*Uts. (Tons Sq. In.)*	*Elongation % Min.*	*Special Properties and Uses*
DTD.424	Copper 3% Silicon 5% Manganese, Iron, Magnesium, Nickel, etc. } Impurities Remainder Aluminium	9	2%	Good fluidity and corrosion resisting properties. Suitable for engine crank cases and parts, electrical apparatus, wringers, and for almost any item within its physical properties. Material developed in war time to use up scrap dural sheet and now very popular for post-war uses. Ingot price reasonable.
DTD.428	Copper 7% Zinc 3% Silicon 3% Minor Impurities Remainder Aluminium	8		This alloy is very similar to 732 alloy used before the war, and primarily used for simple die castings, having good fluidity and ease of casting. No outstanding properties. Ingot costs low.
LAC.113B	Zinc Copper Other Impurities Remainder Aluminium	9	2%	Suitable for commercial work, where castings are not subject to high stress or shock. Similar to commercial L.5 material used before the war. DTD.424 is now more popular and a better all round material.
3L.5	Zinc 13% Copper 3% Minor Impurities Remainder Aluminium	9	2%	For commercial sand cast work, crank cases, etc.; not very suitable for die castings as is rather hot short. Mostly replaced by DTD.424.
DTD.133C DTD.287	Copper and Nickel Iron Magnesium Silicon Titanium or Colombium Remainder Aluminium	10	2% 2%	This is a superior general purpose material with better properties than those mentioned above. Gives a better proof stress for simple heat treatment. Medium strength material of high shock resistance. The main difference between one material and the other is that titanium is used as a grain refiner in one instance and columbium in the other. Used for aero-engines, crank cases, cylinder blocks and can be used for Class I aircraft castings, petrol pumps, etc.

CORROSION RESISTING ALLOYS

Spec.	*Approx. Composition*	*Uts. (Tons Sq. In.)*	*Elongation % Min.*	*Special Properties and Uses*
2L33	High Silicon 12% Minor Impurities Remainder Aluminium	10½	5%	Good for thin sections. High fluidity, not hot short, highly ductile and can be used for fairly complicated sand or die castings. Shock resisting. It is modified by metallic sodium or sodium salts to give its best qualities. Used for crank case sumps, water pumps. marine castings, and for small light assemblies.
DTD.240	High Silicon 12% Iron, Magnesium, Manganese } 0.60% max. Total other impurities 0.2 max. Remainder Aluminium	11	1½%	High Silicon Aluminium, high fluidity and similar casting properties to L.33. Single heat treatment only and usually called for where higher strength is necessary with lower ductility.
DTD.245	Similar to above.	15½		Same analysis as DTD.240 but fuller heat treatment solution and precipitation. Higher strength still with lower ductility.

The Silicon alloys generally do not machine easily, tend to tear and finish is poor. Tapping has to be carefully watched. Tool technique has to be carefully considered to obtain best results. Anodises a greyish colour, not suitable for colouring.

DTD.165	Magnesium 3-6% Manganese 0.5% Total impurities 1% max. Remainder Aluminium.	9	3%	Good resistance to atmospheric and sea water corrosion. Not easy to cast in complicated shapes. Excellent for marine applications. Machines well and takes a nice polish. Anodises and colours well.

HIGH STRENGTH ALLOYS

DTD.298	Copper 4-5% Silicon 0.9%, Iron 0.7%, Titanium 0.25% } max. Other minor impurities Remainder Aluminium	14	7%	High purity material. High strength and shock resisting, used on vital Class I aircraft castings. Specialised technique required, very hot short. Full solution heat treatment, quench in cold water. Is used for control column heads, aileron controls in aircraft and has been used as a substitute for light alloy forgings.
DTD.304	Similar to above	18	4%	Same analysis as above but a fuller heat treatment, solution and precipitation. Same casting characteristics with a higher ultimate strength and slightly less elongation.

HIGH STRENGTH ALLOYS (*cont.*)

Spec.	*Approx. Composition*	*Uts. (Tons Sq. In.)*	*Elongation % Min.*	*Special Properties and Uses*
DTD.300A	Magnesium 10% Aluminium With minor impurites	17	7%	Gives mechanical properties midway between DTD.298 and DTD.304. It is used on die casting jobs where the above mentioned alloys cannot be used owing to their hot short properties. Less cracking is experienced with this material. Specialised technique required. Solution heat treatment, quench in oil.
Y Alloy BSS.L.35	Copper 3.5-4.5% Nickel 1.8-2.3% Magnesium 1.2-1.7% Minor Impurities Remainder Aluminium	14		This material is very useful for the manufacture of castings where strength is required at elevated temperatures. It is a very strong alloy with high Brinell and it is particularly useful for internal combustion engines, pistons, cylinder heads, etc. Better as a die than sand casting. Solution heat treatment, quench in boiling water and leave for four hours.

SIMPLE POINTS OF DESIGN

Now that we have covered a little ground relative to the different characteristics that can be expected in various alloys, bearing in mind the analysis and heat treatment, if called for, let us consider the application of this information as regards design.

The choice of the material, the purpose for which it is required and the design of the component must inevitably be considered at the same time, each one affecting the other, and it is the results of the combination of these three in a properly balanced form which make for efficiency and satisfaction in the final design.

Difficulty is always experienced in a foundry when patterns or dies are supplied by customers with instructions to make a number of castings in a certain alloy, the equipment often proving unsatisfactory for economical manufacture by the particular methods employed by the foundry. This frequently involves the employment of unnecessary complicated foundry technique, with perhaps a subsequent high percentage of scrap resulting in a high price. In the case of dies it is difficult to modify them to adapt an alloy for which the apparatus was not originally designed. This applied to many dies a few years ago, when, owing to shortage of certain materials, substitute alloys had to be used. Runners and feeders had to be modified and in some cases dies had to be entirely re-made for use with the new specification called for.

Section thicknesses must be adequate and be such as to allow a ready flow of metal to all parts of the mould and the necking of intermediate sections which would tend to restrict this flow should be avoided. Heavy sections adjacent to thin ones are also unfavourable and the thin sections should be arranged in proportion to the heavy ones or the heavy sections reduced. This can be done in a number of ways. Bosses could be cored out providing sufficient taper is allowed or, in the case of bosses necessary on internal walls, these could be lightened out from the outside, this being specially necessary where they are situated in a remote part of the casting where feeding direct on to the section cannot be done.

Adequate radii must be used where possible, not only to obviate cracking while cooling in the mould, but also to distribute the stresses more evenly over a larger area when the casting is in use. Taking a case of a simple angle fixed on the base and subject to stresses at right angles to the fixed plane, the metal on cooling will crystallise at right angles to the plane and at the point of intersection of each a line of crystal weakness will be formed. This can be avoided by radiusing at corners and thus avoiding a cleavage plane. This principle should be applied in general to all intersections and in designing web, wall and boss junctions. This inside radius being in tension distributes the strain and would tend to neck in similar to a test bar when highly stressed. Whilst this is a simple point it must not be passed over too lightly as it is fundamental to efficient foundry practice. Even in these days it is often necessary for dies to be returned to the Tool Room for sharp corners to be eased owing to trouble with castings cracking in the mould, or when stressed in subsequent machining operations. Where a sharp corner is essential at a local point it is sometimes better to machine or file away the cast radius so as to ensure a sound casting in the first place.

The design of the casting should be as simple as possible, allowing generous tapers for extraction of cores, two degrees being fairly satisfactory.

If a parallel wall is required for a location or bearing surface it should be stated on the drawing and a good taper allowed for on the opposite wall to compensate. Avoid undercuts or internal projections to eliminate multi-piece cores which take longer to operate and are expensive to maintain. It is not practical to lay down a minimum thickness for walls as this depends on the size of the casting and the surface area, and the adjacent maximum thickness required, but as a general guide it is not advisable to specify below $\frac{1}{8}''$ even on a simple design and using a high fluid alloy such as 2L33.

The ideal design, of course, is for the metal in the casting form to cool together with the feeders being kept alive until this has

taken place. This unfortunately is very difficult to achieve in practice. For the most part we have chiefly considered the design from the foundry point of view and not from the mechanical aspect ; the Designer has other considerations to bear in mind, especially if replacing an existing part made in cast iron by a light alloy casting, the most important being lower modulus of elasticity for light alloys. This is in the region of 10×10^6 pounds per square inch.

In cases where the casting is subject to stresses which tend to distort it and it is essential that it be rigid for design reasons, it will be necessary to increase the sections to give a higher section modulus. It is clear that for a given load the elastic deformation of an aluminium alloy will be about $1\frac{1}{2}$ times that of cast iron and extra strengthening is needed to be comparable. On the one hand, a slight distortion may regularise the stresses through the general body of the casting without vital interference with its objects but in certain instances, when in a key position, it may effect the working of adjacent parts and be unsatisfactory. The comparatively low yield point of aluminium alloys must also be borne in mind.

Where flanged castings are held together to provide oil-tight joints, these should be thickened up or webbed to give the necessary stiffness. Bosses should also be larger in diameter than is normally necessary for cast iron, so as to distribute the load over a larger area. Centres of bolt holes should be arrived at bearing strength and rigidity of the section in mind. It is usually preferable to bolt aluminium parts together by means of studs or bolts rather than use set screws, especially if the parts have to be dissembled at intervals for cleaning or other purposes. Aluminium threads tend to wear if subjected to too much stressing and friction. Threads should also be tapped to a good depth, about twice the diameter of the stud. It is practicable, of course, and advisable in certain instances to cast steel or brass inserts into the casting where the use of a thread is part of the function of the design. To sum up, therefore, the following points are the chief things to bear in mind when designing for aluminium :

(1) Section thicknesses must be adequate to allow ready feed to all parts of the mould and must be as uniform as possible.

(2) Adequate radius must be allowed at all web wall and boss junctions to prevent cracking, also to give smoother flow of metal into mould cavity.

(3) Generous tapers must be provided internally for the extraction of cores and on outside projections to prevent binding on external parts of the casting. Undercuts which lead to multi-piece cores or sand cores should be avoided,

as both increase the cost of the article. Choose a simple design where high strength, hot short materials, are to be specified.

(4) Design adequately, using large radii to blend out abrupt changes of section for strength purposes, bearing in mind the lower modulus of elasticity and proof stress given by light alloys.

(5) In cases where pressure tightness is required, do not design walls too thin.

(6) Use deep threaded studs or bolts, rather than set screws for clamping together points which have to be dissembled fairly frequently.

SIMPLE DIE DESIGN

When the drawing is received from the customer for quotation purposes, this is passed along to the die designer for estimating the weight of the casting and making a rough sketch of the proposed die design, from which is estimated the quantity of castings which can be produced per day in the foundry, and so back to the estimating department, who, on the information received, submit to the customer the part cost of the equipment and price of the casting. The die designer's first considerations, therefore, must be :

(1) The quantity of castings called for and the alloy to be used. This information is required to assist the designer to put forward a design for the die so that the part cost of this would be economical when amortised over the total quantity of the castings called for. For instance, if 1,000 castings only are called for a single impression die would probably be advised, so as to keep the cost as low as possible. On the other hand, if 10,000 castings are called for, the designer most probably will provide a multi-impression die which will not only reduce the cost of the casting, owing to the more rapid production, but will more readily absorb the higher cost of the tool charge over the larger quantity. This would result in a cheaper price per piece.

(2) The complexity of internal coring has to be considered to see whether it is possible to have an all steel core. Even if the core is to be made in several pieces for the convenience of extraction it is preferable to a sand core for various reasons. One of the drawbacks to using sand cores is the finish, especially where it is necessary for the wall surface to be smooth, and another is the fact that it may leave a fine sand residue which it is essential to clean away, as in the case of pump components. There is also the difficulty in dispersing the gas from the core caused by the flow of hot metal. In the case of sand castings this gas will flow

through the rather porous mould, but when enclosed by the steel die it has less opportunity and is normally forced back through the core. If this is not done efficiently the gas will force its way through the light metal, causing porosity and blow holes. It is possible, of course, to use a green sand core with a natural bond where less gas is formed, but these are rather delicate to handle in the foundry and tend to lose their sharp form and accurate shape. In the case of a sea sand core this is much easier to handle, being harder, but is liable to give off more gas owing to the special bonding agent used. The cost of the casting also is higher due to the fact that the separate operation in the making of the cores, baking, etc., has to be allowed for and a high standard of accuracy has to be maintained. In the case of a multi-piece core this takes longer to extract and there is fairly heavy maintenance in keeping the adjacent edges sharp so that junction lines do not show up badly on the casting.

(3) The next consideration is how the casting is to be fed to give progressive solidification. There are two main ways of doing this ; one is to feed the metal in at the furthest part from the heavy sections. This is done so that the temperature of the metal is reduced by the time it has been fed through the die and round the heavy section and thus reduces the crystallisation shrinkage at this point. This will give a sounder casting and smaller grain size at the heavy sections, and also progressive solidification. The other way is to feed in at the heavy sections so that as the casting cools, live metal is fed into the heavy section to make up for the loss of volume which would normally occur in changing from liquid to solid. In this particular case, whilst the heavy section would be sound, the slower cooling would give a larger grain size and the sections would not be so strong as in the case of the first method.

(4) The splitting of the die naturally depends on where the casting is to be fed and also where it is easier to pour, owing to the outside contour of the casting. This is very often complicated as it is not always possible to feed at a spot which is convenient to the splitting of the die. Apart from this we have to consider the die machinist, and design in such a way that the various awkward contours can be machined in the simplest manner with the machines at his disposal. Sometimes it is necessary to divide the die into a number of pieces for machining purposes and then bolt together into a unit.

(5) Fettling of the casting, that is the removing of runners and risers, has to be considered so that this is a fairly simple operation and it is better to include these on a flat face which can be reached easily with a bandsaw, or on a face which has to be subsequently machined as called for by the designer. The question of time taken for fettling is very important as the time cycle for producing a casting can be considerably increased and a gain made by high casting production can be lost if the fettling operation is awkward and costly.

It is important that the gates are designed so as to admit the metal as gently as possible and free from turbulence, to avoid oxide inclusions and trapped air. Dies are normally made of close grained cast iron although steel is used in the case of multi-piece cores. The advantage of steel cores is that they can be rebuilt at the corners by welding, which is difficult to do in the case of cast iron. This is necessary as the corners gradually wear and form a flash line which looks unsightly and obstructs the cores in their removal. High grade steels such as chrome vanadium are sometimes used for small and delicate cores, as these would not normally stand up to the conditions imposed upon them in lesser grade materials.

It is necessary when dimensioning the die to make a contractional allowance so that the castings at normal temperatures will be the correct size. This varies in normal designs from between .006 to .008 per inch. Clearances must be arranged so that the die will work easily when hot. There must be no undue slackness, however, which would produce inaccuracy in the finished casting or allow metal in the form of flash to penetrate between the die sections. Lever slots are normally provided for opening the dies and in the case of large dies with heavy parts, the movement can be eased by racks and pinions or air cylinders. This, of course, is rather costly and depends upon the number of castings called for.

From the above notes it will be seen that the die designer has a big responsibility in designing and producing a die which is to work easily and efficiently to provide rapid production of castings which are sound and satisfactory to the customer. Not only do these have to be dimensionally accurate, but sound and of a good finish and any concession asked for by the Designer to make his burden easier should have every consideration by the Production Engineer.

PRODUCTION OF A CASTING

We will assume that the die is now made, has been checked over in the Inspection Department and is ready to go into the Foundry for producing the sample casting, which is normally sent to the customer for approval before proceeding with the bulk order.

The die is first heated up, care being taken that this is done

gently otherwise there is a danger of distortion and cracks developing. The internal cavity and the cores are sprayed with a die dressing which consists mainly of a preparation of talc and water glass. This is put on evenly so as to give the castings a good finish and also to protect the die from the erosion of the aluminium. The dressing dries almost instantaneously on the hot die. The die is then assembled. In the meantime the aluminium alloy ingot must be smelted in a convenient furnace, those mostly used being of the bale-out type. Care must be taken that the metal is not overheated; the temperature should not exceed 800°C. The casting should be poured at the lowest possible temperature, consistent with the metal, and properly filling the mould cavity. Great care must always be taken to ensure that the ladle is dry before dipping into the hot metal and most founders after using the ladle put these on the side of the furnace to keep it hot. The clean metal, having been fluxed and made suitable, is ladled from the furnace and poured evenly and smoothly into the die by way of the ingate, and left to solidify. The metal will quickly freeze but the die is not opened until the gates and feeder heads have solidified. Small round cores are then withdrawn to relieve stresses in the casting and the main core is then extracted. The outside of the die is then opened and the casting exposed for removal. This sequence of operations is repeated. It may be necessary to make a number of castings to obtain a correct working temperature of the die before good castings are produced, and proper technique and optimum time cycle general for the type of casting is obtained. Certain adjustments may be necessary to size of gates, thickness of die dressing, alteration of metal temperatures, etc., before production of good castings is going smoothly.

Every job has its own teething troubles and various adjustments have to be made to overcome misruns, porous patches, blow holes, etc. The ordinary bale-out type of furnace is very popular for this work and a plumbago or carborundum crucible is generally used, but these have to be used carefully to give a good life. Cast iron pots are sometimes used but these have to be heavily coated to prevent erosion by the aluminium, which ultimately eats them away with the result that a certain amount of iron is picked up in the aluminium which, in the use of certain alloys, is not to be recommended. At the same time the heat transfer is more rapid through iron crucibles than the plumbago, especially when most of the plumbago has been burnt out of the pot leaving the refractory base. The reverberatory type of furnace is usually used for melting larger batches of material, which is relayed to the bale-outs for direct use in pouring the castings. On the larger type of die it may be necessary to use three or four men, pouring simultaneously so as to get the metal into the die more quickly over the larger area

and also to even up the heating of the die. After the casting is extracted from the die, it is allowed to cool and then sent along to the Fettling Department to have the feeders and excess metal removed, and to be filed and cleaned to comply with the drawing. The casting is then passed along to the Inspection Department.

INSPECTION

Samples are first normally coloured or whitened and marked up in the Inspection Department, so that an accurate dimensional check can be made with the drawing. This casting is usually sent to the customer for his approval. Examination of castings in bulk production is then considered and in certain cases jigs are made for accurate checking, especially of large castings. Castings are checked for soundness, those having blow holes, porous patches, etc., being returned to the foundry for remelting.

Cracks and minute faults are detected by a powerful magnifying glass, the Glo-crack system, or X-ray. In the Glo-crack system the casting is heated up in a tank, using immersion heaters, the fluorescent liquid used penetrating into cracks and crevices. The casting is then washed off in a hot bath and allowed to dry. In the dark room, under a neon lamp, the fluorescent residue gives off a phosphorescent glow in the shape of the defect ; this is ringed round with pencil by the operator as it cannot be seen under ordinary natural light. Another method is to heat up the castings in a mixture of oil and paraffin, dry off in sawdust, then cover with a coating of chalk. The casting upon cooling will exude this oil mixture and discolour the white chalk. X-ray, of course, is used for the inspection of Class I or Class II castings for aircraft, as it is possible by this method to see internal defects which otherwise cannot be revealed. Cracks, porosity, shrinkage, blow holes, etc., can be seen by this method, both on the X-ray screen or by means of photographic negatives. Sometimes several shots have to be taken from different angles on the casting to get the desired depth of penetration required according to the thickness of the section.

The inspection of castings by X-ray was originally introduced on account of the necessity for a definite check as regards the soundness of castings for vital parts of aircraft, but since its introduction it is now used in wider commercial fields. It is of especial value for checking porosity, in the case of commercial productions such as fuel pumps, and in castings generally where the cost of the casting is low compared with the cost of machining. It is advantageous therefore, in certain instances to pay a little more for the casting and institute a percentage X-ray, to reduce machining expenditure per piece. Apart from this, X-ray can be used to

establish casting technique. Sample batches are made and then X-rayed until the technique is correct so that bulk production can commence on a firm foundation.

Mr. L. R. Carr wrote a paper called " THE QUANTITATIVE INTERPRETATION OF RADIOGRAPHS IN TERMS OF MECHANICAL PROPERTIES " which goes very deeply into the radiographic techniques, the main object being to show the definite correlation between radiographic evidence and mechanical properties.

This line of investigation opens a new field of development but it is one of personal experience and investigation. It can only be built up by experiment in actual cutting up or taking tensile tests from castings, which are carefully examined in conjunction with their radiographs.

MACHINING AND FINISHING OF CASTINGS

It is not possible in the confines of this paper to discuss these items at length, as both machining and finishing of aluminium castings are specialised jobs. It could be mentioned, however, in connection with machining that there is a big difference in the machining qualities of various aluminium alloys. Those of the higher Brinell usually give a much better finish. The high silicon alloys as a rule are difficult to machine and do not give a really good finish. This depends greatly on tool technique, speeds, etc., and lubricants used. It is always essential that the edges of tools are ground carefully so as to eliminate a wire edge, otherwise a build-up of aluminium on the cutting edges is to be expected.

Tungsten carbide tipped tools are very popular for the machining of large repetition quantities of light alloy castings, and they are used in large quantities for machining pistons. They hold their size for much longer periods than ordinary high speed steels ; the aluminium tending to be abrasive, they are normally sharpened on diamond-impregnated wheels to obtain the desired accuracy and fine finish required. The machining of aluminium is very much faster than cast iron as the cutting speed can be taken as high as permissible by the machine used to give the accuracy called for. High surface speeds with small feeds and cuts are preferable.

Lubricants usually used are paraffin and a mixture of paraffin and cutting oil, or sometimes suds oil.

In the tapping of threads more care has to be taken as there is always a danger of the threads tearing and well backed off ground thread taps should be used with a suitable lubricant. It is better for holes to be bored slightly in excess of standard Whitworth sizes, which would tend to produce a small flat on the tip of the thread. This helps to prevent tearing and does not weaken the threads. Diamond tools are used in the machining of pistons to give a very

fine finish, but it is essential that the castings supplied are free from oxide inclusions, otherwise very high charges for replacement diamond tools will be occasioned. This also applies to tungsten carbide tipped tools.

FINISHING

The majority of aluminium castings are used in their natural state but are sometimes anodised, polished, or enamelled as called for. In the case of anodising this is chiefly done :

(1) to harden up the surface as in the case of pistons.

(2) for corrosion resistance purposes.

(3) followed by colouring for decorative purposes.

Most aluminium casting alloys will anodise to improve their corrosion resisting properties, but to anodise and colour for decorative purposes is a different story. Pure aluminium as normally seen anodised and coloured in sheet form is a very suitable application, but this cannot be applied with any great success to the general run of commercial casting alloys owing to the unsuitability of the alloying constituents for this purpose. The addition of silicon, for instance, gives a dull grey finish to the casting. It is not suitable for decorative purposes, and will not take any colour except black. The aluminium magnesium type of casting is more satisfactory but unfortunately casting technique is somewhat limited in complicated shapes. It is advisable, therefore, when considering decorative forms of anodising for an aluminium casting to consult the anodising specialist or see samples in the particular material chosen before going all out on production.

Aluminium will polish very well and is a very attractive finish. This process, however, is fairly costly especially if a high degree of finish is required. Simpler forms of barrel polishing can be used but this does not produce the polish which is obtained by using a sequence of emery bobs, finished off on suitably graded mops with tripoli, and white finishing composition. It is necessary to have a good skin finish on the casting otherwise this process is very lengthy. Die castings are far preferable to sand castings as the slightest surface defect will spoil the look of a polished article. Incidentally it is necessary to get a very high polished surface for satisfactory coloured anodising.

One of the best finishes on aluminium gravity die castings is the enamel crackle finish. This is very attractive in appearance and covers up slight defects, fettling marks, etc., and it is not necessary to polish the article before carrying out this operation. Anodising makes a very good bond for the enamel and stops undue flaking.

As regards polishing and plating, certain firms are now specialising in this and rapid advances in techniques are being made. It is advisable, therefore, to consider seriously the method of finishing at the outset and seek expert advice in order to save much disappointment and many headaches in producing the finished article.

(*Reproduction of the photographs appearing on the following pages is by courtesy of John Dale, Ltd.*).

FIG. 1. Corner of sand foundry.

FIG. 2. Sand casting in high strength alloy, D.T.D.300 Radius Rod for aircraft.

Fig. 3. Typical Die Castings showing saving of machining.

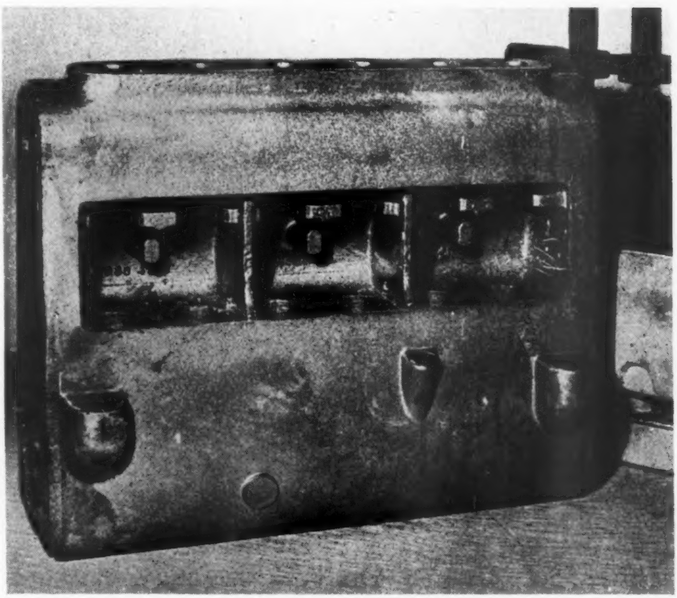


Fig. 4. Pump casting with sand core.

Fig. 5. Die with sand core.

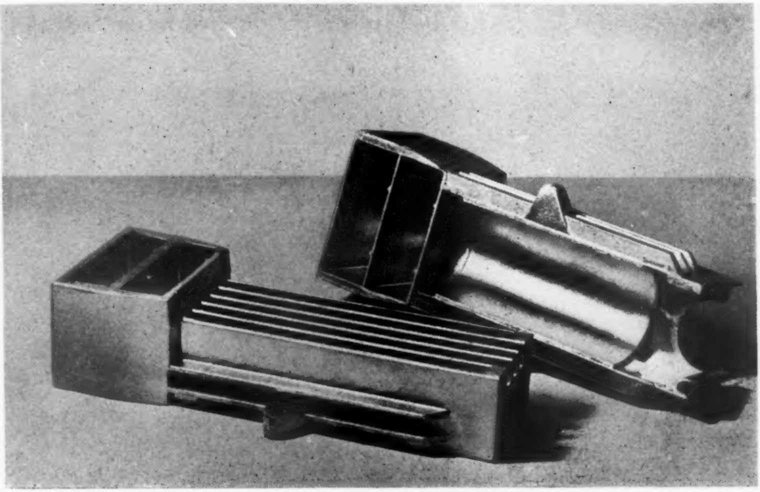


FIG. 6. Evaporator casting.

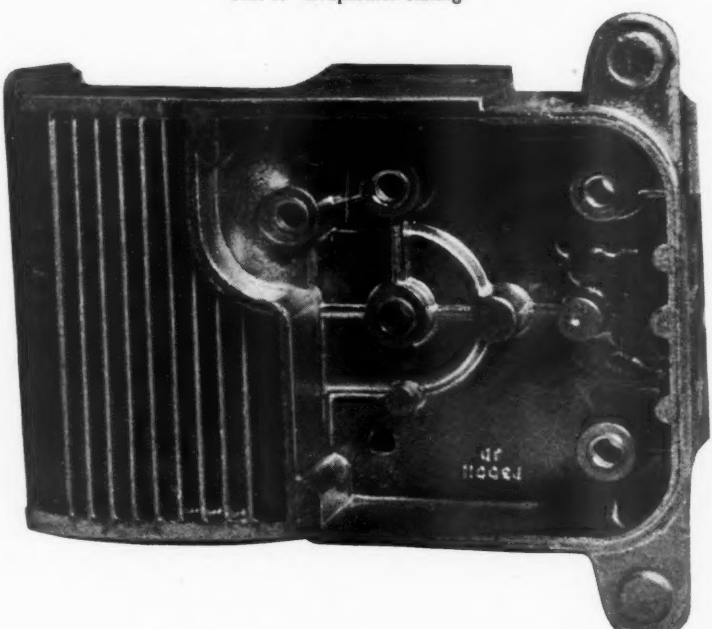
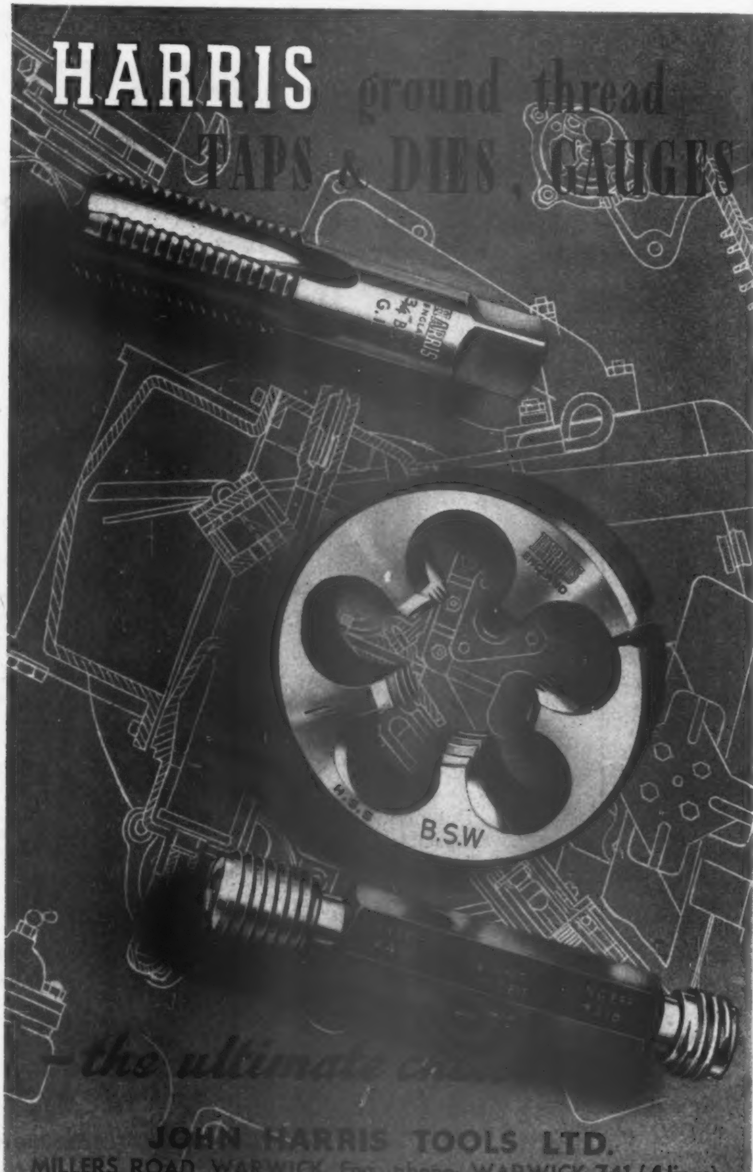


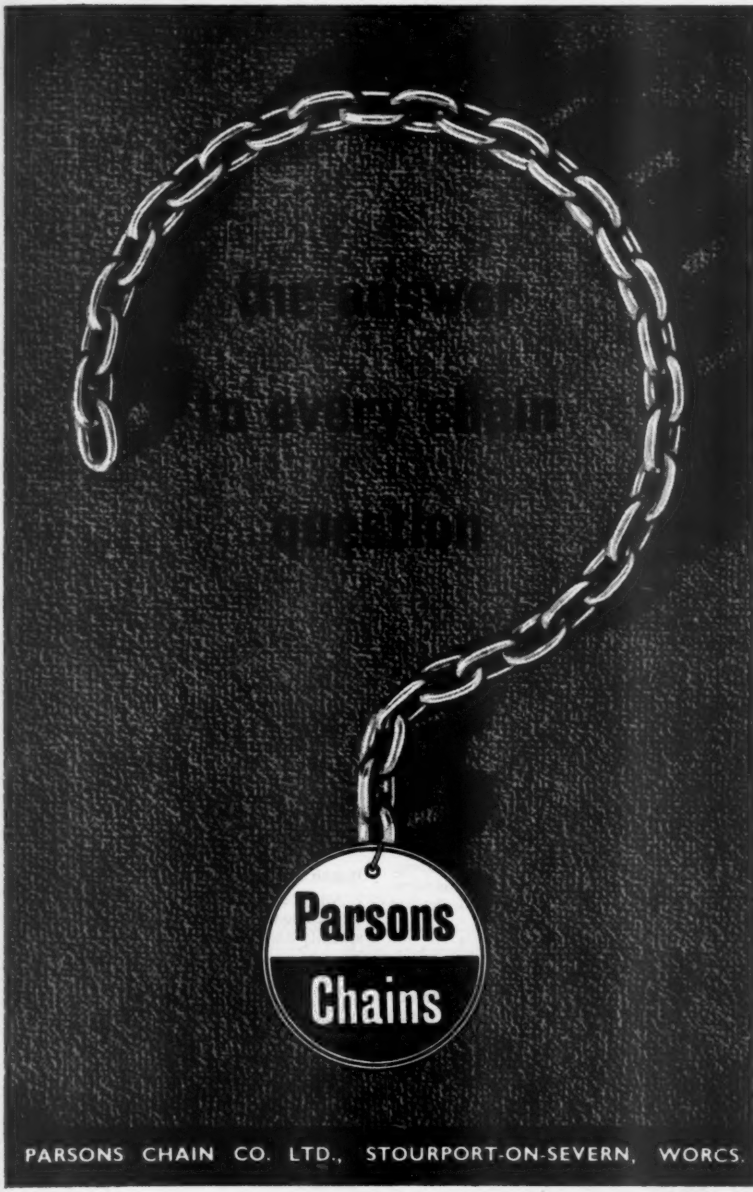
FIG. 7. Complicated casting made practical by attention to design.

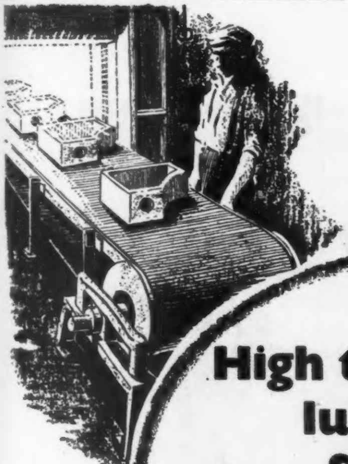
FIG. 8. Evaporator casting being extracted from Die.

FIG. 9. Crankcase sump working a large Die.

FIG. 10. Inspection by X-Ray.


HARRIS ground thread
TAPS & DIES, GAUGES
B.S.W
JOHN HARRIS TOOLS LTD.
MILLERS ROAD, WARWICK, Eng. phone: WARWICK 741 (4 lines)


Parsons
Chains
PARSONS CHAIN CO. LTD., STOURPORT-ON-SEVERN, WORCS.

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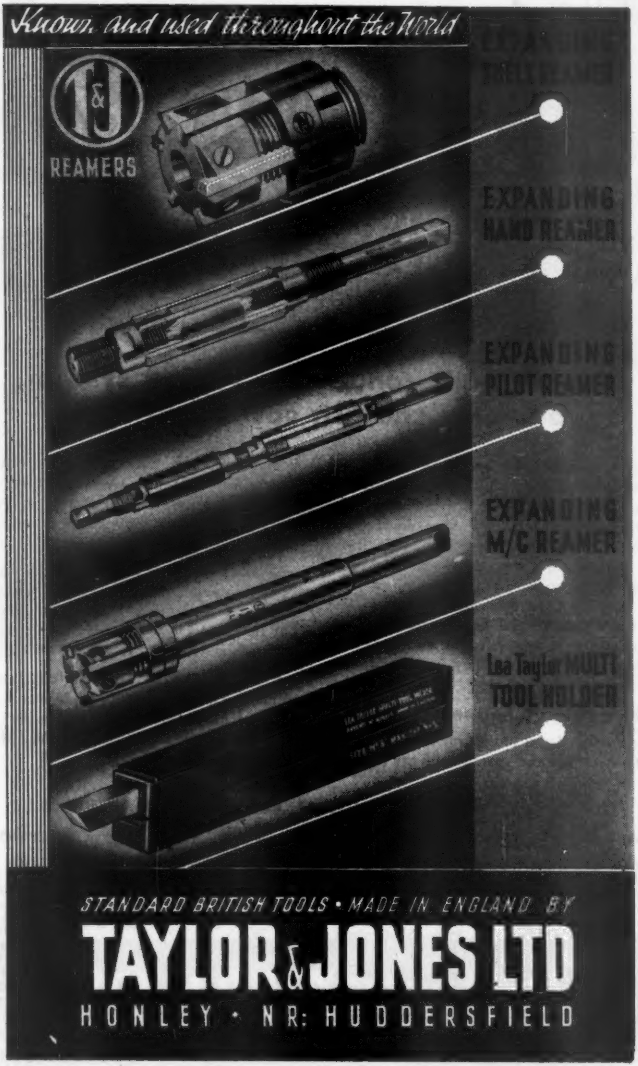
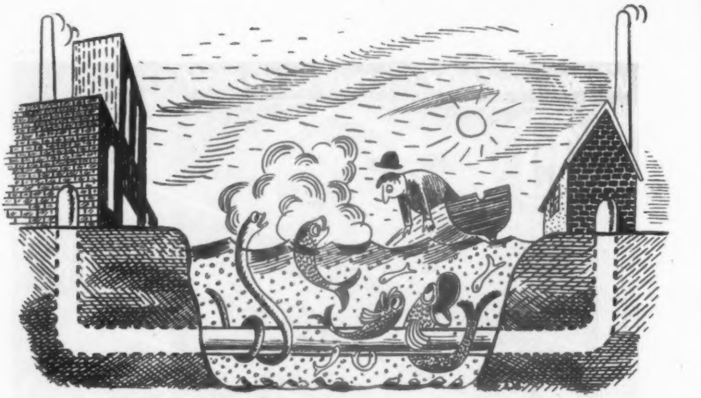

Known and used throughout the World
T&J
REAMERS
EXPANDING HAND REAMER
EXPANDING PILOT REAMER
EXPANDING M/C REAMER
Lea Taylor MULTI TOOL HOLDER
STANDARD BRITISH TOOLS • MADE IN ENGLAND BY
TAYLOR & JONES LTD
HONLEY • NR: HUDDERSFIELD



A well-built condensate return system, but only the fish got the benefit!

The management of a certain works went to great trouble to install a condensate return system, but were discouraged to find that they were still getting cold water to feed their boilers. The Ministry's Fuel Engineer, who happened to hear of their difficulty, discovered that the return main passed through a river on its way back to the boiler house. The result was a fine central heating plant for the local fish and an equally effective cooling system for the condensate which they had taken such care to collect.

This wouldn't happen to you!

Of *course* not. But it did happen to someone! And this is no isolated instance of the obvious being overlooked. We all have our blind spots, and however familiar we are with an installation or a process, we are liable to pass over bad or out-dated practices that a fresh pair of eyes would spot in a moment.

Wouldn't you be wise to ask the Ministry's Fuel Engineer to pay you a visit—just in case? Not only is he rich in practical experience, but he can look at the job from a fresh point of view.

By the way, have you referred to "The Efficient Use of Steam" by Oliver Lyle? It can be ordered through any bookseller (886 pp., 15/- net), or obtained from H.M. Stationery Office, 15/9 post free.

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Midland	Temporary Office Buildings, Hagley Road West, Birmingham, 17	Bearwood 3071
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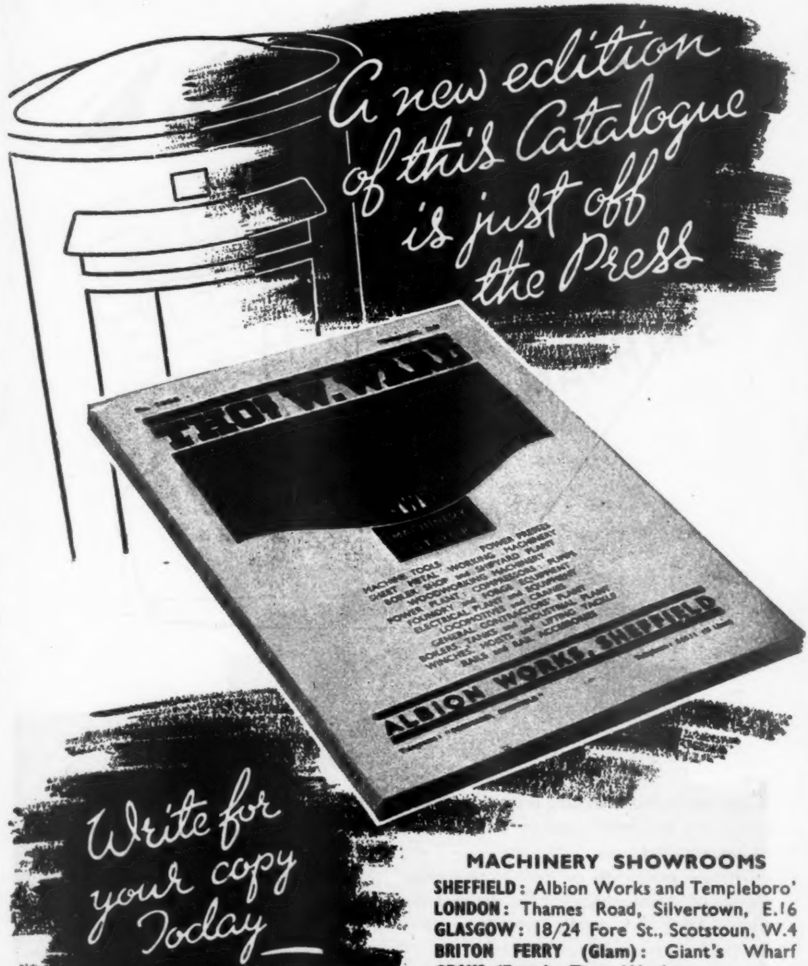
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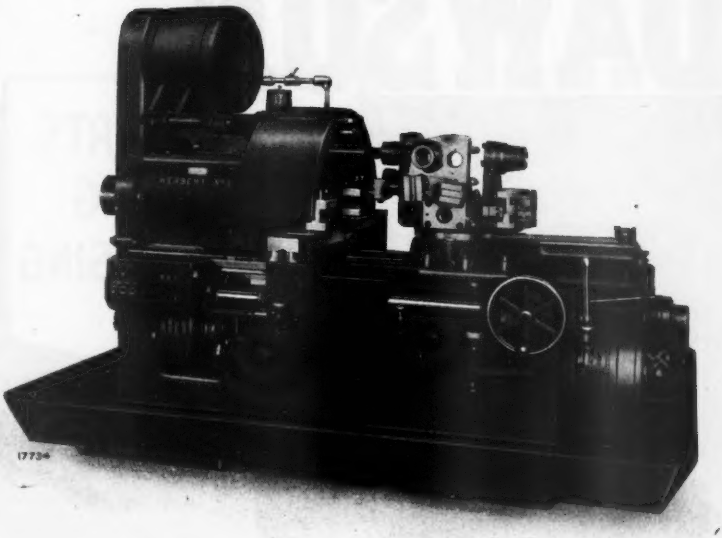

No. 4 AUTO-LATHE (SPLASH GUARDS OMITTED)

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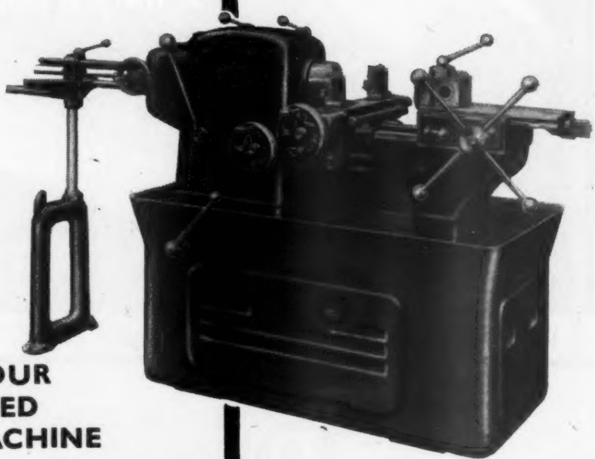

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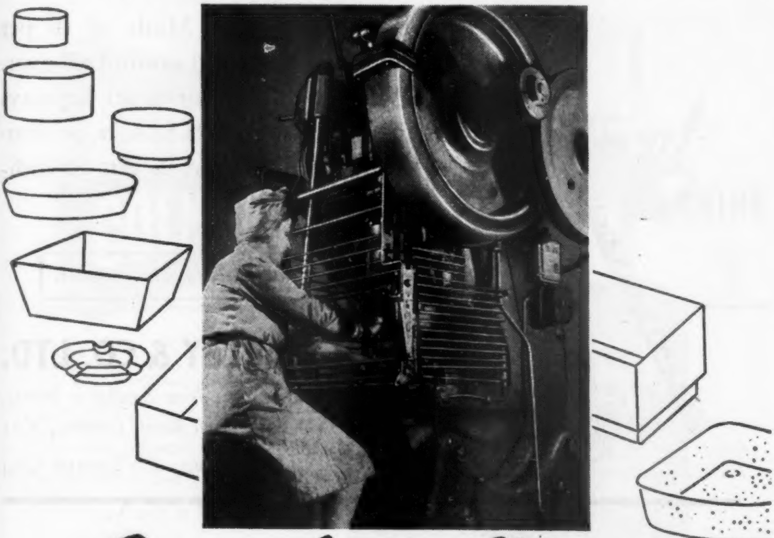

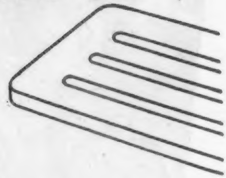

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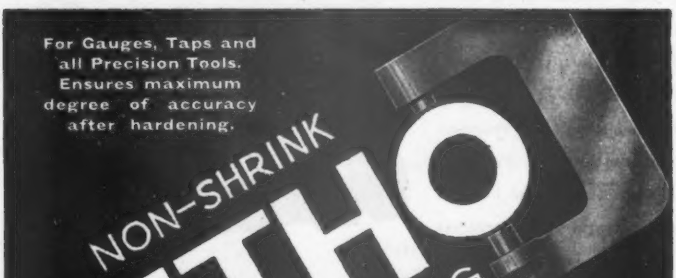

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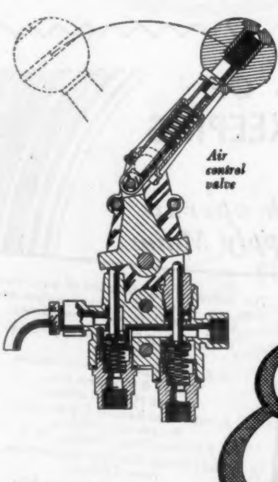

Now, don't say "my work's different!" You can't really say till you've had a talk with us. And please don't put the matter aside. If you don't need air clamp equipment we shall soon tell you. If you do need it — you need it *now*. Let's get together on this.

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AIRCLAMP PNEUMATIC EQUIPMENT

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Now, here's a CASE...

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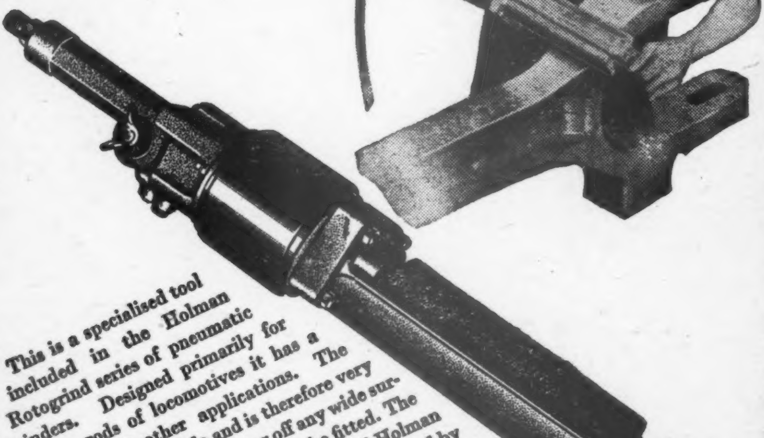
Loco Rod Grinder



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